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GB 2265267 A GB 1527277 A GB 1425861 A
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(54) Abstract Title

Power supply with rechargeable battery and DC/DC converters

(57) During a battery recharge mode an adapter 13 converts an external AC voltage into a DC voltage from which a DC/DC converter 20 provides a charging voltage for recharging a battery 12, and during an operational mode the battery 12 supplies a first load 30 via a DC/DC converter 10 and a second load 40 via the DC/DC converter 20. The DC/DC converter 20 thus has a dual role, whereby the number of DC/DC converters required can be reduced compared to a prior arrangement (Fig. 1). DC/DC converter 20 acts as a down-converter during the recharge mode and as an up-converter during the operational mode. During the recharge mode, current and voltage control signals are applied to the DC/DC converter 20 by a recharging control circuit 11 which senses battery voltage and current. A switch 80 allows the second load 40 to be powered via the DC/DC converter 10 during the recharge mode. During the operational mode switches 50 and 70 are closed and switches 60 and 80 are open, and during the recharge mode switches 60 and 80 are closed and switches 50 and 70 are open. The switches 50, 60, 70 and 80 may be controlled by a microprocessor according to activation/deactivation of AC/DC adapter 13. Alternatively, switches 60 and 80 may be NMOS transistors, and switches 50 and 70 may be PMOS transistors with gates driven directly by the output of adapter 13.

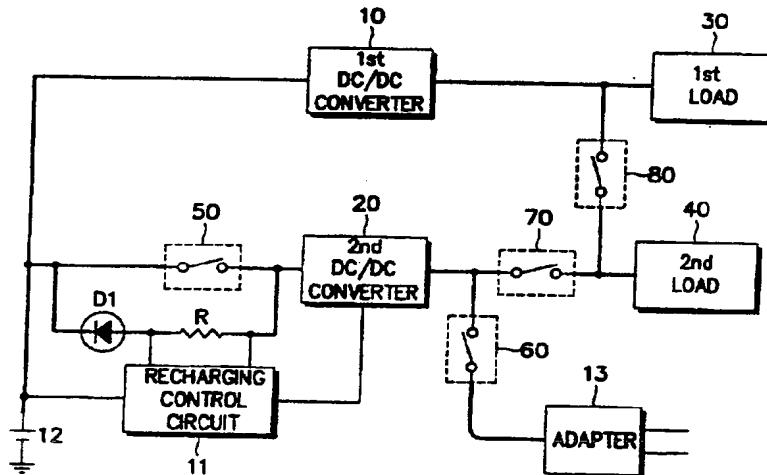


FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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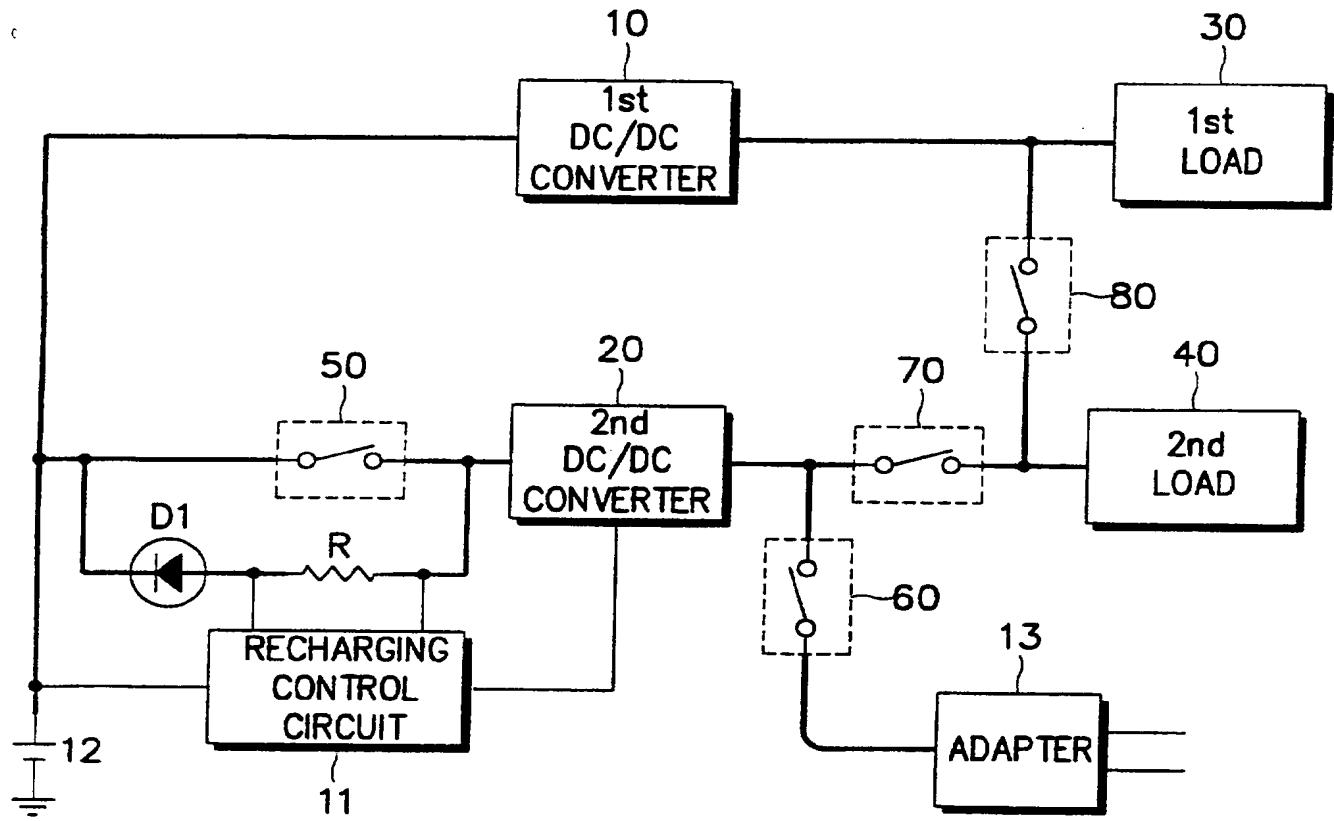


FIG. 2

the drawback of a costly and complex structure. The complexity of the structure increases the size of the power supply, which is undesirable if the power supply is to be used with a portable terminal. Accordingly, there exists 5 a need for a simple and compact power supply suitable for use with a portable terminal.

Summary of the Invention

Accordingly, the present invention provides a power supply 10 for supplying power to first and second independent loads comprising:

a rechargeable battery for generating a battery voltage;

15 a first converter coupled to the battery for converting the battery voltage into a supply voltage, the first converter being adapted to provide a supply voltage to the first load during an operational mode; and

20 a second converter coupled to the battery, adapted to convert the battery voltage into a supply voltage and provide the supply voltage to the second load during the operational mode and adapted to convert an external voltage into a charging voltage and provide the charging voltage to the rechargeable battery during a battery recharge mode.

25 Such a power supply advantageously does not use an independent converter for recharging the battery and thereby reduces the size and complexity of the power supply.

30 In a preferred embodiment, the first converter is adapted to provide a supply voltage to both the first and second loads during the battery recharge mode.

35 A power supply according to the present invention may further comprise an adapter coupled to the second converter for converting an external AC voltage into a DC voltage and adapted to provide the DC voltage to the second converter during the battery recharge mode.

between the first converter and the second load.

Preferably, the power supply also includes second switching means for coupling the second converter to the second load
5 during an operational mode and connecting it to the adapter during the battery recharge mode. The second switching means may comprise a second switch positioned between the second converter and the second load and a third switch connected between the second converter and the adapter.

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It is also preferred that third switching means are provided for controlling the activation of the recharging control circuit. The third switching means may comprise a fourth switch connected in parallel with the diode and
15 resistors.

Preferably, the switching means of the present invention comprise MOS transistors.

20 It is also preferred that the switching means are controlled in accordance with the supply of an external voltage to the power supply.

25 Brief Description of the Drawings

The present invention will now be described with reference to the accompanying drawings in which:

Fig. 1 is a schematic block diagram of a conventional power supply; and

30 Fig. 2 is a schematic block diagram of a power supply according to a preferred embodiment of the present invention.

Detailed Description of A Preferred Embodiment

35 Fig. 2 illustrates a power supply according to the present invention. The power supply comprises a first load 30, a second load 40, first and second converters 10 and 20, a rechargeable battery 12 and an adapter 13. As illustrated in the drawing, the first load 30 is adapted to share the

second load 40. The charging control circuit 11 is connected to the rechargeable battery 12. The charging control circuit 11 senses the voltage of the rechargeable battery 12 and generates a voltage control signal in accordance with the sensed voltage, during battery recharging. The charging control circuit 11 is also connected in parallel to the resistor R. It senses the charging current passing through the resistor R and generates a current control signal in accordance with the sensed current, during battery recharging.

The voltage and current control signals generated by the charging control circuit 11 are provided to the second DC/DC converter 20. The second DC/DC converter 20 controls the charging voltage and the charging current it outputs in response to the voltage control signal and the current control signal.

During normal operation, i.e. when the battery is not being recharged, first and third switches 50 and 70 are closed while second and fourth switches 60 and 80 are open. Thus, during normal operation the charging control circuit 11 is not active and the first and second DC/DC converters 10 and 20 are connected respectively to the first and second loads 30 and 40. Accordingly, during normal operation, the first converter 10 converts the voltage output by the battery 12 into a supply voltage and provides the supply voltage to the first load 30. Similarly, the second converter 20 converts the voltage output by the battery 12 into a supply voltage and provides the supply voltage to the second converter 20.

On the other hand, in the battery recharging mode, the second and fourth switches 60 and 80 are closed, and the first and third switches 50 and 70 are open. Thus, the charging current from the second DC/DC converter 20 flows into the rechargeable battery 12 through the resistor R and the diode D1, to recharge the rechargeable battery 12. The current flow activates the charging control circuit 11.

response to a driving signal generated by a microprocessor (not shown) upon detecting activation of the adapter 13.

Thus, the present invention provides a portable power supply with a structure simpler than those of conventional devices. The structure is simplified by reducing the number of DC/DC converters used. The reduction in the number of converters is made possible by not using an independent converter for battery recharging. The structural simplicity reduces both the size and the cost of the power supply.

the control signals to the second converter during the battery recharge mode.

6. A power supply according to claim 4 further comprising
5 a charging control circuit coupled to the second converter
and the battery and connected in parallel with the resistor
and diode, for generating control signals which depend on
the charging voltage generated by the second converter and
adapted to provide the control signals to the second
10 converter during the battery recharge mode

7. A power supply according to claim 6 in which the
charging control circuit is adapted to sense the voltage of
the rechargeable battery and the current passing through
15 the resistor to generate a voltage control signal and a
current control signal during the battery recharge mode.

8. A power supply according to claim 6 or claim 7 in
which the charging control circuit is activated by the flow
20 of current through the resistor during the battery recharge
mode.

9. A power supply according to any one of claims 5-8 in
which the second converter is adapted to control its
25 voltage output in accordance with the control signals.

10. A power supply according to any preceding claim
further comprising first switching means for connecting the
first converter to the second load during the operational
30 mode.

11. A power supply according to claim 10 in which the
first switching means comprises a first switch positioned
between the first converter and the second load.

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12. A power supply according any of claims 3-12 further
comprising second switching means for coupling the second
converter to the second load during an operational mode and
connecting it to the adapter during the battery recharge



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Patents Act 1977
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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): G06F 1/26, 1/28, 1/30; H02J 7/00, 7/02, 7/04, 7/10, 9/00, 9/04, 9/06.

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	GB2265267A (CYBER) - see dual mode converter 4	1,3-9,12 at least
X	GB1527277 (TOKYO SHIBAURA) - see converters 2, 58 in Fig.4	1,3 at least
X	GB1425861 (ELECTRIC FUEL) - see converter ABC in Fig.21, and the converter in Fig.27	1,3,5,12 at least
Y	EP0028591A1 (JUNGNER) - see dual mode converter 16,22,36 in Fig.2	1,3-9 at least
Y	WO79/01127A1 (CHLORIDE) - see dual mode converter 10 in Fig.1	1,3-9,12 at least
Y	US4709318 (LIEBERT) - see dual mode converter 52 in Fig.3	1,3-9 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

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P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.